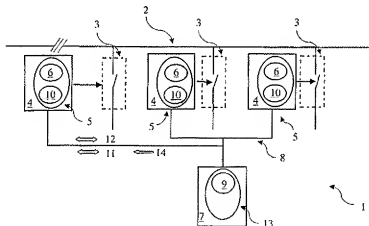


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(54) Title: **AN IMPROVED PROTECTION AND CONTROL SYSTEM**

(57) Abstract: A P & C system for a power distribution network, comprising one or more pieces of primary equipment (such as tripping devices or disconnectors or the like). The P & C system, according to the present invention, comprises at least a digital P & C device associated to a piece of the primary equipment of the power distribution network. This digital P & C device comprises at least a local control unit including a microprocessor for providing the digital generation of signals for controlling the piece of primary equipment, to which it is associated. Further, the P & C system, according to the present invention, comprises at least a remote computerized apparatus, which is connected to the digital P & C device by means of a predefined communication network. The P & C system, according to the present invention, is characterized in that the remote computerized apparatus comprises a remote control unit, which is provided with a remote software (SW) communication platform for remotely interfacing a user with the control unit of the digital P & C device. The remote SW communication platform exchanges data/information, related to the configuration of the digital P & C device and to the operating status of the digital P & C device and/or the power distribution network and provides said local control unit with data/information related to the control of the primary equipment of the power distribution network.

AN IMPROVED PROTECTION AND CONTROL SYSTEM

DESCRIPTION

The present invention relates to an improved protection and control system for a power distribution network.

- 5 It is known that traditional protection and control (P&C) systems comprise one or more digital P&C devices, associated to pieces of the primary equipment included in the power distribution network (i.e. associated to tripping devices or disconnectors or the like). One of the main functions of a digital P&C device is to monitor the operating state of the power distribution network on which it is installed. Another important task consists of the control of the operation of the
10 piece of primary equipment, to which it is associated, depending on the results of the monitoring activity. The functions of a digital P&C device are regulated by a control unit, which includes a microprocessor. Based on predefined processing strategies, the microprocessor provides for the digital generation of
15 signals for regulating the functions of the digital P&C device.

A user is generally allowed to interact with the control unit, for example in order to set up the most appropriate processing strategies, by means of a human-machine interface (commonly called user-interface or HMI) of the digital P&C device. The HMI allows the user to program the functions of the P&C device.
20 Further, the HMI allows to display data/information regarding the status of the digital P&C device and, more in general, to display the results of the monitoring activity, which is run by the digital P&C device on the power distribution network.

According to the needs, a traditional P&C system can comprise one or more
25 digital P&C devices interconnected, by means of a proper communication network, to a remote computerized apparatus having supervising purposes.

Traditional P&C systems have some drawbacks.

A main drawback is related to the fact that, in traditional P&C systems, the HMI is substantially integrated with the structure of the digital P&C device. This fact

implies a low scalability in terms of performances and costs of the digital P&C devices that are adopted in a P&C system.

In fact, different versions of the HMI may imply different kinds of the correspondent digital P&C device.

- 5 Moreover, when the HMI is integrated, modifications/changes of the HMI may imply substantial changes of the correspondent digital P&C device.

Another drawback is that there is a forced one-to-one correspondence between HMI and the digital P&C device, so, in the P&C system, each digital P&C device requires a dedicated HMI. In addition it is not possible to choose where
10 to install the HMI, because, being integrated, it must be installed on the front door of the switchboard where the digital P&C device is located. The integration of the HMI in the digital P&C device also requires that the HMI is customized according to the digital P&C device HW/SW architecture and cannot be based on a standard off-the-shelf platform (e.g. an industrial PC). All the above
15 mentioned facts imply that the HMI has a significant impact on the costs of the digital P&C device and more in general on the total P&C system. This fact determines strong cost constraints for the HMI. These constraints oblige to realize HMIs with relatively low processing capabilities (i.e. low graphic resolution, low processor power, low memory and the like).

- 20 Eventually, due to the drawbacks described above, one can say that traditional P&C systems do not provide satisfactory performances.

Therefore, the main aim of the present invention is to provide a P&C system for a power distribution network, which allows overcoming the mentioned drawbacks.

- 25 Within this aim, another object of the present invention is to provide a P&C system, which is provided with a user-interface architecture, which allows overcoming the constraints and limitations described above.

Another object of the present invention is to provide a P&C system, which allows achieving a remarkable level of scalability, in terms of costs and performances.

Not the least object of the present invention is to provide a P&C system, which is relatively easy to realize at competitive costs.

Thus, the present invention provides a P&C system for a power distribution network, comprising one or more pieces of primary equipment (such as tripping devices or disconnectors or the like). The P&C system, according to the present invention, comprises at least a digital P&C device associated to a piece of the primary equipment of the power distribution network. This digital P&C device comprises at least a local control unit including a microprocessor for providing the digital generation of signals for controlling the pieces of primary equipment, to which it is associated. Further, the P&C system, according to the present invention, comprises at least a remote computerized apparatus, which is connected to the digital P&C device by means of a predefined communication network.

The P&C system, according to the present invention, is characterized in that the remote computerized apparatus comprises a remote control unit, which is provided with a remote software (SW) communication platform for remotely interfacing a user with the control unit of the digital P&C device. The remote SW communication platform exchanges data/information, related to the configuration of the digital P&C device and to the operating status of the digital P&C device and/or the power distribution network, with said local control unit, by means of the predefined communication network. Further, the remote SW communication platform provides said local control unit with data/information related to the control of the pieces of primary equipment to which the digital P&C device is associated.

Further characteristics and advantages of the P&C system, according to the present invention, will be better described hereinafter, with particular reference

to the enclosed figure 1, which schematically illustrates a block diagram representing the digital P&C device, according to the present invention.

Referring to figure 1, it is shown a preferred embodiment of a P&C system (reference 1), according to the present invention. The P&C system 1 is dedicated

5 for the use in a power distribution network 2, which comprises one or more pieces of primary equipment 3. The P&C system 1 comprises at least a digital P&C device 4, which is associated to one or more pieces of primary equipment 3 of the power distribution network 2. The digital P&C device 4 comprises at least a local control unit 5, which includes a microprocessor 6 for providing the

10 digital generation of signals (not shown) for controlling the pieces of primary equipment 3, to which the digital P&C device 4 is associated. The P&C system 1, comprises also at least a remote computerized apparatus 7; which is connected to the digital P&C device 4 by means of a predefined communication network 8. The remote computerized apparatus 7 comprises a remote control

15 unit 13, provided with a SW communication platform 9 for remotely interfacing a user with the local control unit 5. The remote SW communication platform 9 exchanges with the local control unit 5, by means of the predefined communication network 8 some data/information 11 and 12. Data/information 11 are related to the configuration of the digital P&C device 4 and

20 data/information 12 are related to the operating status of the digital P&C device 4 and/or the power distribution network 2. The exchange of data/information 11 and 12 may be of the bi-directional kind. The remote SW communication platform 9 provides the local control unit 5, by means of the predefined communication network 8, also with data/information 14, related to the control

25 of the primary equipment of the said power distribution network. In this case, the exchange of data/information 14 is basically of the mono-directional kind. Preferably, the local control unit 5 comprises at least a SW communication module 10 for supporting communication between the local control unit 5 and the SW communication platform 9, by means of the predefined communication

network 8. Advantageously, the remote SW communication platform 9 may communicate with the local control unit 5, according to a master-slave communication procedure. For this aim MODBUS or SPABUS communication protocols or the like may be used. Alternatively, the remote SW communication platform 9 may communicate with the local control unit 5, according to an event-driven communication procedure. In this case known TCP/IP-Ethernet or CAN communication protocols or the like may be used.

The communication network may be of the wired kind (such as for example plastic or glass fiber optics, twisted-pair RS-485 network, or the like) or of the wireless kind (GSM; radio-frequency network or the like).

The advantages of the P&C system 1 should be noticed.

The remote SW communication platform 9 allows realizing an improved user interface architecture. In fact, the user is allowed interact with the local control unit 5 of each digital P&C device 4, only by means of the remote SW communication platform 9. Therefore, from the user's point of view, the remote SW communication platform 9 constitutes a unique HMI for all the digital P&C devices 4 that are included in the P&C system 1.

By means of the remote SW communication platform 9, the user is allowed to automatically download/upload data/information from/to each of the digital P&C device 4.

Therefore, the user may perform easily, at a remote level, the automatic insertion/collection of data/information 12 related to the operating status of each digital P&C device 4 and/or the power distribution network 2. On the other side, the user also can perform easily, at a remote level, the automatic programming of each digital P&C device 4, by means of downloading/uploading data/information 11 related to the configuration of each digital P&C device 4. Further, the user can provide easily the local control unit 5 with instructions related to the control of the primary equipment of the power distribution network, by means of automatically uploading data/information 14.

Preferably, the remote SW communication platform 9 may comprise different customized computerized environments (not shown), preferably in a WINDOWS®-like format, each of which may be used for interfacing with one or more of the digital P&C device 4.

5 The advantages are remarkable. No HMI is to be installed aboard of a digital P&C device 4 and each of the digital P&C devices 4 may be realized, according to standard specifications, with a remarkable reduction of fabrication and installation costs.

Further, the remote SW communication platform 9, due to the fact that it is
10 included in the remote computerized apparatus 7, may be powered according to the needs. Therefore, new and more powerful functionality may be implemented, according to the needs, with relatively low additional costs.

Different configurations of the P&C system 1 are possible. For example, as illustrated in figure 1, the P&C system 1 may comprise a single remote
15 computerized apparatus 7, connected to one or more of digital P&C devices 4. Alternatively, in a more extended configuration (not shown), the P&C system 1 may comprise also a plurality of remote computerized apparatuses 7 and a plurality of digital P&C devices 4. In this case, each of said remote computerized apparatuses 7 are connected to one or more of digital P&C devices
20 4. Obviously, also intermediate configurations are possible.

Taking into consideration the above described advantages, one can say that the P&C system 1 allows achieving all the intended aims and objects. In particular, it has proven to fully overcome the constraints and limitations described above and to achieve high scalability levels, particularly in terms of costs and
25 performances.

Further, the practice has also shown that the P&C system 1, according to the present invention, is of relatively easy realization and at competitive costs.

CLAIMS

1. A P&C system for a power distribution network, comprising:

- at least a digital P&C device associated to one or more pieces of primary equipment of said power distribution network, said digital P&C device comprising at least a local control unit including a microprocessor for providing the digital generation of signals for controlling said piece of primary equipment; and

- at least a remote computerized apparatus, said remote computerized apparatus being connected to said digital P&C device by means of a predefined communication network;

characterized in that said remote computerized apparatus comprises a remote control unit, said remote control unit being provided with a remote SW communication platform for remotely interfacing a user with said local control unit, said remote SW communication platform;

- exchanging with said local control unit, by means of said predefined communication network, data/information related to the configuration of said digital P&C device and data/information related to the operating status of said digital P&C device and/or said power distribution network;

- providing said local control unit, by means of said predefined communication network, with data/information related to the control of the pieces of primary equipment, to which said digital P&C device is associated.

2. A P&C system, according to claim 1, characterized in that said local control unit comprises at least a SW communication module for supporting communication between said control unit and said remote SW communication platform, by means of said predefined communication network.

3. A P&C system, according to one or more of previous claims, characterized in that said remote SW communication platform communicates with said local control unit according to a master-slave communication procedure.

4. A P&C system, according to one or more of claims from 1 to 2, characterized in that said remote SW communication platform communicates with said local control unit according to an event-driven communication procedure.
5. A P&C system, according to one or more of previous claims, characterized in that said local control unit is accessed by the user uniquely by means of said remote SW communication platform and said predefined communication network.
6. A P&C system, according to one or more of the previous claims, characterized in that it comprises one or more of said digital P&C devices, a single remote computerized apparatus being connected to said one or more of said digital P&C devices.
7. A P&C system, according to one or more of the previous claims, characterized in that it comprises a plurality of remote computerized apparatuses and a plurality of said digital P&C devices, each of said remote computerized apparatus being connected to one or more of said digital P&C devices.
8. A P&C system, according to one or more of previous claims, characterized in that said remote SW communication platform comprises one or more customized computerized environments for allowing a user to interface remotely with the local control unit of one or more of said digital P&C devices.

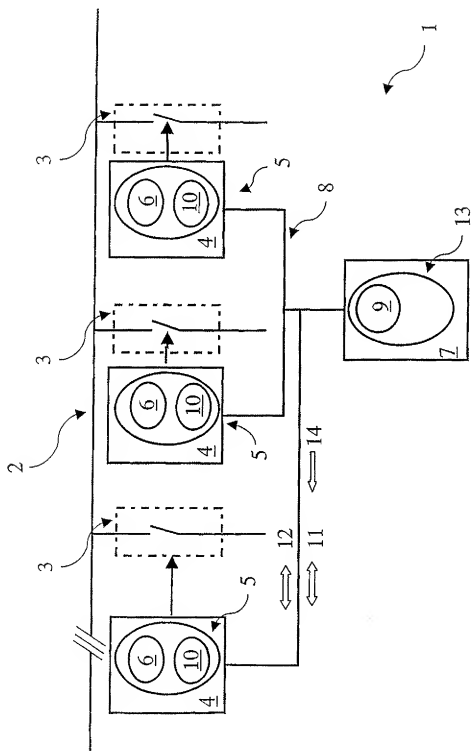


Figure 1